Pushing the envelope

MAKING YUKON HOMES GREEN

Yukon Development Corporation

energy solutions centre

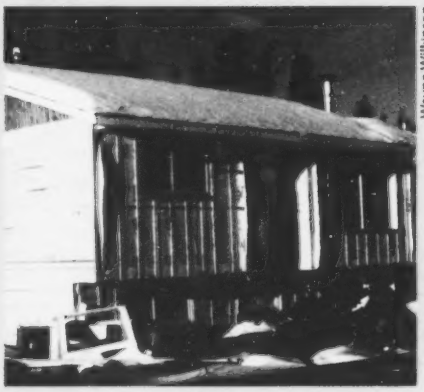
YUKON ENERGY

Canadian Home Builders' Association YUKON

YUKON HOUSING CORPORATION

GOING GREEN WITH YOUR HOUSE

Courtesy of Trish and Joel Luet



Wayne Wilkinson

Today, no one would design a home in the Yukon without planning for insulation or thinking about heating costs. But how many people consider:

- the impact their heating fuel will have on the environment,
- the energy required to produce the construction materials (embodied energy),
- how much water the building will use,
- its impact on the household's transportation energy costs, or
- the effect it may have on its site?

When you ask these kinds of questions before you build, buy or renovate, you are on your way to a green house, one that consumes fewer resources, offers improved air quality and has less environmental impact. Over its lifecycle, a green home should even cost less.

In the Yukon, there are two formal programs, both delivered by Yukon Housing, that set out guidelines for green homes: the Natural Resources Canada/Canadian Home Builders' Association R-2000 building program and the certified Green Home program. Houses built under these programs can cut energy use by about a third. And compared to conventional houses, new R-2000 homes also reduce water use. That could be especially important if you rely on water delivery.

The R-2000 and Green Home programs offer the home builder access to computer energy modelling that shows how a house will use energy and where design changes can be made to improve its efficiency.

If you're building your own home, that's a real advantage because you can refine construction features to get the best energy value for your building dollar.

Home buyers and renovators can get similar high tech help from an EnerGuide for Houses energy audit. As a buyer, you can compare houses that have been audited. The EnerGuide rating will tell you which has greater efficiency and will be cheaper to operate.

If you are renovating, the audit will show you what changes will improve energy efficiency and how long it will take to recover improvement costs through energy savings.

Whether you're building, buying or renovating, working with an experienced person who knows energy efficient housing can help you to make better decisions, get the best value for your money, and put you and your family into a greener house.

How to use this publication

The more you know about green homes, the better you'll be able to house yourself and your family. Throughout this publication, the shaded boxes on the bottom of the right-hand pages contain information to consider if you are building, buying or renovating.

Take a walk with us through Yukon housing history. As you do, give some thought to the changes you could make to the way you house yourself to:

- conserve the shared environment we all value, and
- minimize the resources needed to build, renovate and operate your home.

Green homes have lower impacts on their environment and use less energy, in both their construction and use, than conventional homes.

Self-help sections

- ✓ Picking a lot
- ✓ House siting
- ✓ Financing
- ✓ House designs
- ✓ Choosing a contractor
- ✓ Foundation
- ✓ Framing
- ✓ The envelope
- ✓ Windows
- ✓ Materials and finishing
- ✓ Energy systems
- ✓ Heating
- ✓ Ventilation
- ✓ Water conservation
- ✓ Appliance and lighting selection

In a series of evening classes, the "Self-Help" program, offered by Yukon Housing, takes potential builders through the steps of home building.

Cover photo: Larson trusses on the Luet house. Courtesy of Trish and Joel Luet. More information on this house is on page 24.

BUILDING IN THE YUKON

Shelter is a basic human need that we all approach in different ways, depending on our circumstances. Our environment, and our values and attitudes, as well as those of the society around us, affect how we house ourselves and our family.

Materials, labour, technology, and their cost, all affect the choices we make while designing, building and renovating a house.

In times of subsistence and survival, basics are what count. When we have economic stability, we pay more attention to comfort and aesthetics. When external factors change

(top) Kramer/Benedek R-2000 house, Spruce Hill. (bottom) Constantly changing Hillcrest homes.

✓ Picking a lot

Choosing where to live is an intensely personal choice. Yukoners are strongly attached to landscape and community.

Your home's location will have significant implications for your future resource and energy use. Builders, buyers and renovators might all want to consider:

- access to work, shopping, services, schools and recreation,
- transportation options: can you walk, cycle, take the bus or will you have to drive most places?
- access to electrical services: if none, what are the alternative energy options?
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- access to sun,
- boreal forest risks such as fire and edge-tree blow-down around clearings,
- impacts on wildlife habitat.

Decentralized development in the Whitehorse area

In the past, Yukon communities were located along major transportation routes, originally the waterways, and then the highways. Many people still live in housing that is clustered in these communities.

But just as prospectors and miners spread out and housed themselves on the creeks where they found what they sought, today, thousands of Yukoners who fled the south in search of a sense of freedom choose to make their homes on their own claims to the wild.

As a result, the Yukon government and municipalities have developed country residential "subdivisions" adjacent to many Yukon communities.

These developments have a downside. They can alienate wildlife habitat and result in increased consumption of fossil fuels to meet transportation needs. They may also require greater consumption of manufactured goods to meet servicing requirements than in neighbourhoods with municipal water and sewer systems.

C = country residential *T = trailer*
S = serviced subdivision *I = industrial*

GOING GREEN WITH YOUR HOUSE

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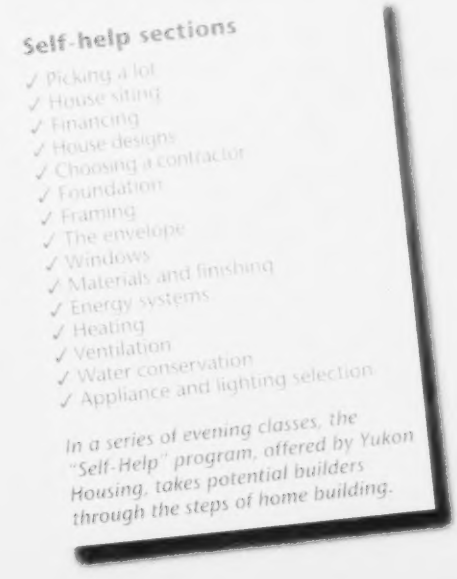
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— for instance, energy costs rise — we see our shelter through a new lens, and look for ways to cut our costs.

Building choices have long-term implications: for instance, money saved today on cheaper windows or less insulation will be spent on higher energy costs and maintenance for years to come.

The Yukon and Canada lead the world in efforts to encourage good energy choices when we design and build. In the early 1980s, Yukoners pioneered techniques for residential energy auditing, now used throughout Canada. The R-2000 building program that continues to set an international standard for energy efficient housing also has roots here.

Some Yukoners are looking at a broad range of environmental and energy factors before they build. They are part of a growing trend towards ecological building that goes even beyond the R-2000 targets.

Yukon Archives, Coutts Coll. PHO 95, #239

Tr'ondëk Hwëch'in brush shelters, 1895.

A LOOK BACK

First Nations tradition

A hundred and fifty years ago, the first people of the Yukon lived with the land. Their shelters were shaped by the skins of the animals they hunted, and by the land through which they moved on their seasonal migrations: from berry areas to salmon streams, caribou hunting grounds to trading places.

Concepts we now consider part of the "green" or ecologically appropriate building vocabulary — such as low embodied energy, micro-climate sensitivity, siting for solar heat gain, water conservation, minimal site disruption, and so on — were practised on a daily basis. Why shelter under poles carried from afar if you could build with what was close at hand? Why not camp out of the wind where the sun could warm you? Why haul more water than you could drink? Why waste energy felling a whole tree if a branch would meet your needs?

Early contact

As early fur traders and prospectors moved through the country, there was little to distinguish their living arrangements from those of the original inhabitants. While the first peoples carried hides, the prospectors carted canvas tents. Both made the structures to support their shelters from what they found around them. The wise among them camped for convenience near water, in the sun during winter, in the shade during summer, and all cooked over open fires.

When traders and prospectors over-wintered, a frontier tradition of shelter developed. The axes and saws the newcomers brought with them allowed the harvest of whole trees and their use as logs for buildings.

They notched the logs to build walls, chinked the gaps with moss and used poles to support sod roofs.

With hundreds of hectares of free wood just outside their doors, little attention was paid to energy efficiency, despite a harsh climate with startling swings in temperature.

Unlike builders on the agricultural "frontiers" of the American Midwest and the Canadian prairies, the early Yukon adventurers did not often see their shelters as permanent, or even as steps towards enduring habitation. For most of them, fur and later gold were the goal, not settling. They were here to make their fortune and get out.

The gold rush era

The rush of prospectors to the Klondike at the end of the 19th century created tent cities along the Yukon River and its headwaters. As

Yukon government

Yukon government

(above) Cabin at Rampart House used simple notches for the corners and a pole roof. (right) White Fang movie set, re-creation of stampeder tents.

the stampeders moved on, the tents went with them.

In 1898, Dawson City sprung up on the banks of the Yukon River. Frame buildings soon found a place among the tents and log cabins erected by early arrivals. As the city became a centre of government, it developed social aspirations, expressed in buildings such as the Commissioner's Residence.

The tilting buildings and storefronts that typified Dawson City in later years testified to the unstable ground conditions created by melting permafrost. Experienced Dawsonites learned to protect the permafrost with sawdust insulation and built on mudsills, and later on cribbing, that let them jack their houses up or down as the ground moved.

The tent city of White Horse began on the east side of the river below the rapids. When the White Pass and

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Commissioner's Residence, Dawson City, built in 1901, refurbished in 1908 after a fire, and recently restored to its present condition.

National Archives of Canada, PA122806

"...People started to put frame additions on their log homes. Those who still lived in tents framed them in with lumber, often leaving the canvas intact for insulation." *(all quotes from Exploring Old Whitehorse)*
View of Whitehorse waterfront from a sternwheeler deck, ca. 1900.

✓ House siting

How a house is situated on a site makes a major difference to its environmental impacts, energy demands, and building costs.

- Orient the house to the southeast to allow for solar gain.
- Construct access from the south side to leave an opening for sun penetration.
- Leave forest shelter on the north side to protect the house from cold winds.
- Minimize impacts on the natural environment. Remove as few trees as possible.
- Check access to services. Factors such as distances from powerlines or water and sewer connections or the porosity of soil for septic tanks all affect future decisions and costs.

If you're buying or renovating, what you are able to do to improve energy efficiency may already be limited by the location of the house. Think about installing a more efficient window in a north wall to minimize heat loss. Consider a sun porch or bigger windows to take advantage of solar gain. Check whether or not the house's location and local regulations will allow you to expand.

This condominium in downtown Whitehorse is oriented to the south, facing the Yukon River and a spectacular view of Grey Mountain. The front has been landscaped with natural Yukon shrubbery.

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"Often, what began as a temporary log cabin or tent grew into a family homestead. For example, the McKinnon House [on Wood Street] began as a humble cabin."

Yukon Railway pushed through on the west bank in 1900, everyone moved to the new townsite, now downtown Whitehorse.

After a devastating fire in 1905, the town's residents began to erect housing that emulated the frame Victorian and Edwardian structures popular on the west coast. The Dorothy Scott House is a fine example.

Mid-century

A mix of frame and log housing characterized the Yukon through the last century and is still with us today.

Military boom

Like the stampeders, the U.S. military arrived with tents in 1942 to build the Alaska Highway and the Canol pipeline. Then they built housing and barracks both at the airport and downtown. This began a tradition of military housing construction in Whitehorse that lasted into the early 1950s.

After the war, the population of Whitehorse dropped to 5,000 people from a peak of 20,000. About half of them were Canadian military people who managed the Alaska Highway and the Whitehorse airport after the Americans left. The military built new housing complexes to standard Canada Mortgage and Housing Corporation designs at Camp Takhini (army) and Hillcrest (air force) to house its people.

In the early 1950s, the federal government built houses in

"By 1905, Whitehorse houses were built a little larger and with greater care and more flair."
The Dorothy Scott House was built with common sense that has made it a good performer over the years. A large bay window facing south helps warm the whole house with solar heat. Storm windows all around cut heat losses. A ventilator built into the bedroom wall (arrow, above) improves indoor air quality. The front arctic entry minimizes door-opening heat losses. The south-facing window in the bedroom bay brings light into the east side of the house which used to abut a log cabin. John Scott (pictured above, in his living room) added insulation to the walls and attic and extended the house with an addition and full basement in 1954.

"The first frame homes were built as soon as lumber became available and affordable. Small, simple and easy to heat."
Grant House, located on Hanson Street, was a square design. This provided maximum indoor volume with minimum exterior exposure, making the home easier to heat and cheaper to build. Ironically, the glassed-in porch is on the north, street side of the lot, offering no solar heat gain.

"During the depression and second world war, logs were cheaper and easier to obtain than lumber."
The Taylor House, on Main Street, is well oriented on its site. Most of its windows and all three dormers are located on its south side to take advantage of winter sun. The aspen tree in the front yard provides some summer shade.

Valleyview for Department of Transport personnel and other members of the federal civil service. Government employees gradually took over former military responsibilities.

In the downtown area, buildings left by the American military were converted to private use or moved to new locations, a practice that became a Yukon recycling tradition. A few airport buildings were also moved to new lots sold by the federal government along the highway in Porter Creek.

This wartime building, now on Centennial Street in Porter Creek, was constructed by the U.S. military at the Whitehorse airport.

Yukon government

"The army set up a tent camp above the escarpment next to the airport, and built permanent housing and offices nearby. In the townsite below, it constructed barracks and recreational centres for its soldiers."
(above) Early military tents. (below) After a recent retrofit, this Camp Takhini house has an EnerGuide for Houses rating of 74, putting it in the same range as today's energy efficient houses.

✓ Financing

Yukon Housing's Green Mortgage Program offers a preferred interest rate (with a 5% down payment requirement) for building energy efficient homes or upgrading housing to a certified Green Home standard.

To qualify, builders or renovators must:

- register with Yukon Housing, before they begin their design,
- meet specific design standards (primarily based on R-2000 criteria),
- purchase 75% of building materials from Yukon businesses,
- use a Yukon contractor, and
- achieve an acceptable EnerGuide rating when tested.

Other Yukon Housing programs may also help:

- Owner Build Program targets rural Yukoners who want to build but find it difficult to obtain conventional bank financing.
- Home Completion Program may help if you have stalled out on your home's construction.

If you are contemplating improvements to an existing house, Yukon Housing may be able to help through the following programs:

- Home Repair Program and Home Repairs Enhancement Program both provide low interest loans to upgrade housing components, including energy efficiency,
- Mobile Home Upgrade Program provides low interest loans to repair deficiencies in mobile homes, and
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For more information, visit Yukon Housing's website *www.housing.yk.ca.*

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From 1968 to 1981, John Hoyt lived in one half of this Steelox he owned on Dalton Trail. He installed a furnace and ducting in the crawl space and added rigid foam insulation, an air-vapour barrier and new gyproc to the interior walls. After that, he says, his feet were warm and he could see out on days when his neighbours' windows were all frosted over.

This house, built for U.S. Brigadier General James A. O'Connor at the airport, was moved in 1964 to its current location on Alexander Street. In 1989, architectural designer Jim Vautour bought it and his retrofit, including window and insulation upgrades, makes it as energy efficient as most contemporary buildings. He also added a sun porch to the south side to capture solar heat and cut heating bills.

Some military housing appeared misplaced in Whitehorse. The Steelox package home duplexes assembled in Hillcrest in 1951 and 1952 to accommodate air force families seemed better suited to the tropics. Built over shallow crawl spaces, with steel-clad outer walls, paper-backed fibreglass insulation, heating ducts in the ceiling and 10-foot high walls, they were cold and hard to heat during Yukon winters. Large windows and good locations with lots of sun exposure at least made them bright.

Riverdale

In the mid-1950s, the Northern Canada Power Commission started construction of the Whitehorse Rapids power dam, and in 1956, the federal government built a bridge across the Yukon River. This allowed construction of the new hospital and the start of the Riverdale subdivision.

New federal government housing soon went up on Alsek, Tatchun and Tagish roads and on Takhini Avenue. In 1958, the first year people lived in Riverdale, the subdivision only extended as far as Donjek Road on the east and Teslin Road on the south.

(above left) Jo-Ann Waugh grew up in this Teslin Road house, one of the first private homes in Riverdale. In 1958, her father petitioned the government to put in a streetlight so his daughters could find their way home from school. (above right) That same year, Flo Whyard's family moved into this Takhini Avenue government house. "There was nothing but forest around us," she remembers. As is the case with much of the post-war housing in Whitehorse, both of these houses have been upgraded.

(left) These Alsek Road houses were built as one and a half storey government houses in 1960. In 1996, architect Florian Maurer renovated the one on the right. He chose it for its southern orientation and weather-sheltering greenbelt and trees. The hill behind the house protects it from north winds. Deciduous trees (aspen and tamarack) in the front yard, and aspen on the east and west boundaries of the lot, let sun through in the winter and provide shade in the summer. Maurer removed the roof, built full walls on the second storey, used triple pane glazing and increased insulation levels from the basement up.

Mining communities

Through the middle of the last century, two mining companies — United Keno Hill and the Yukon Consolidated Gold Company — sustained a slow Yukon economy.

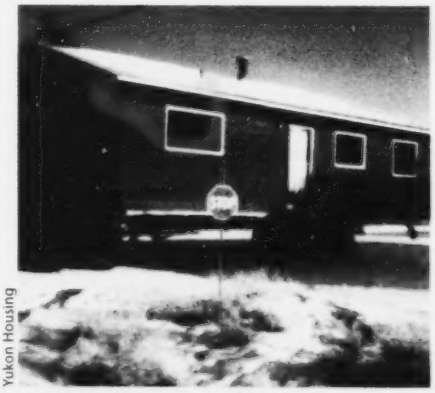
Mining in the Keno Hill area north of Mayo generated a succession of mining townsites that were built and then closed. With each closure, buildings were moved or salvaged for materials.

Mining-driven boom

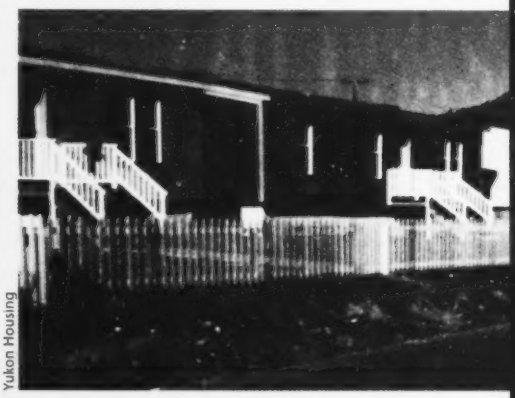
Mining took off in the late 1960s. In 1967, the Clinton Creek Cassiar Asbestos property started up on the Fortymile River near Dawson City. In 1969, the world class Cyprus Anvil lead zinc mine at Faro came into production. In both cases, the

Yukon government

(left) Elsa's houses were sold off in the 1980s when the United Keno Hill Mines closed. The panabodes, originally set up as kit houses years earlier, migrated to other communities, such as Whitehorse (right). With 3½-inch thick cedar walls and roofs, no insulation and leaky, single pane casement windows, these units were not energy efficient.



Yukon Housing



Yukon Housing

Only 10 years after it was built, and 10 years ahead of schedule, the Clinton Creek mine closed. A few years later, the townsite was sold off. (right) Yukon Housing brought some modular units to Dawson City to meet staffing and low income housing needs. (far right) These units were later retrofitted.

✓ House designs

Many Yukoners fall in love with the idea of designing, building or renovating their own houses. But, if you've checked out the real estate market, you know that there are a lot of unusual houses out there — designs that may have worked perfectly for that owner, but fall short of the needs of others. It is important to think long term, to make the best use of your construction dollars, to lower your operating costs and to ensure a good resale value for your home.

Consider signing up for Yukon Housing's Self-Help program. It offers a dry run through the design and construction process in 16, three-hour classes.

If you have a design you like, review it with a building professional. Someone who has built dozens of houses can help you avoid problems, simplify construction approaches and save labour and material costs.

Architects know how to match an owner's needs to the appropriate building design.

Wayne Wilkinson

If you sign-up for the R-2000 or Green Home programs, professionals will work with you to refine your design and assess its energy efficiency before you build. You can save money by making appropriate design choices.

Before you buy a new home, consider getting permission for an EnerGuide for Houses energy audit to tell you how the house you are interested in stacks up against other housing. The audit will also recommend what energy efficiency upgrades will be most cost effective.

Yukon Housing offers an Accommodating Home Mortgage program to encourage greater home utility and easier future renovating.

✓ Choosing a contractor

The Yukon has a well-qualified pool of building professionals: people who lead the rest of the country in building energy efficient housing. If you have friends who are happy with their home, find out who built for them and what their contractors were like to work with. Ask what follow-up has been like for problems that turned up after completion.

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If you're interested in a particular style of building or construction approach, talk with people who have used that approach to locate professionals who have the appropriate expertise.

Natural Resources Canada *(www.nrcan-rncan.gc.ca/inter/index.html)* publishes a brochure entitled, *Building a Home? Ten Questions to Ask Your Builder.* This may help you when you are choosing a contractor.

Also, check with the Canadian Home Builders' Association *(casales@chba.ca, www.chba)* to get a list of its members.

Mining communities

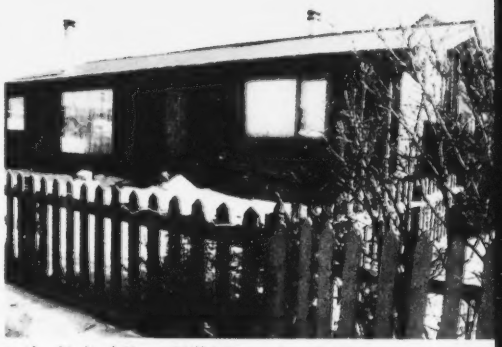
Through the middle of the last century, two mining companies — United Keno Hill and the Yukon Consolidated Gold Company — sustained a slow Yukon economy.

Mining in the Keno Hill area north of Mayo generated a succession of mining townsites that were built and then closed. With each closure, buildings were moved or salvaged for materials.

Mining-driven boom

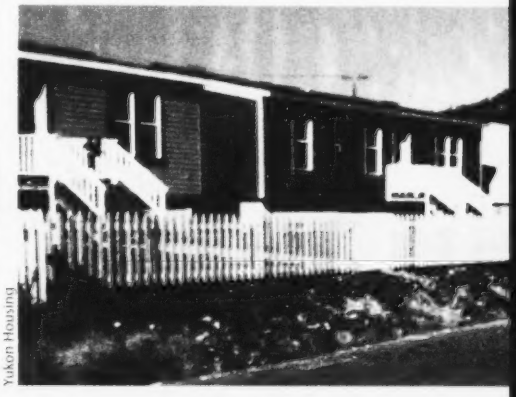
Mining took off in the late 1960s. In 1967, the Clinton Creek Cassiar Asbestos property started up on the Fortymile River near Dawson City. In 1969, the world class Cyprus Anvil lead zinc mine at Faro came into production. In both cases, the

Yukon government



(left) Elsa's houses were sold off in the 1980s when the United Keno Hill Mines closed. The panabodes, originally set up as kit houses years earlier, migrated to other communities, such as Whitehorse (right). With 3½-inch thick cedar walls and roofs, no insulation and leaky, single pane casement windows, these units were not energy efficient.

Yukon Housing



Yukon Housing

Only 10 years after it was built, and 10 years ahead of schedule, the Clinton Creek mine closed. A few years later, the townsite was sold off. (right) Yukon Housing brought some modular units to Dawson City to meet staffing and low income housing needs. (far right) These units were later retrofitted.

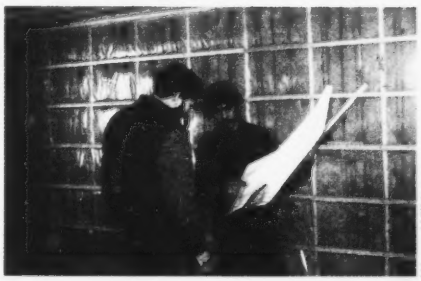
✓ House designs

Many Yukoners fall in love with the idea of designing, building or renovating their own houses. But, if you've checked out the real estate market, you know that there are a lot of unusual houses out there — designs that may have worked perfectly for that owner, but fall short of the needs of others. It is important to think long term, to make the best use of your construction dollars, to lower your operating costs and to ensure a good resale value for your home.

Consider signing up for Yukon Housing's Self-Help program. It offers a dry run through the design and construction process in 16, three-hour classes.

If you have a design you like, review it with a building professional. Someone who has built dozens of houses can help you avoid problems, simplify construction approaches and save labour and material costs.

Architects know how to match an owner's needs to the appropriate building design.



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Yukon government

In 1969, the new Faro townsite had a bleak setting — a raging forest fire destroyed the town part way through construction. Today, Faro is an exception to the Yukon pattern of single industry townsites taken down or moved away when the resource was exhausted. In the case of Faro, it is the town itself that is being recycled, not the buildings. Realtors are selling houses in the heart of the Yukon to people from all over the world.

companies built new towns from scratch.

The Faro mine was the catalyst for a new road from Carmacks, a new powerline, additional generating facilities at Whitehorse Rapids, and later, the Aishihik dam — all built to supply the mine's enormous infrastructure needs.

All of this construction activity and mining development changed nearby communities and placed new demands on Whitehorse. The service and retail sectors grew exponentially and municipal boundaries expanded to take in Porter Creek and Crestview, as well as the area south of town, all the way to the Carcross Road.

New housing sprouted in Porter Creek and Riverdale, forcing the relocation of the cemetery from the Peel Street area to Grey Mountain Road. Package houses from Muttart Homes and Nelson Homes arrived on trucks from the south. Many of these houses were erected with few allowances made for the Yukon climate.

Public sector housing

The government and social housing sectors also experienced growth in the boom years. Teachers, government employees and people with low incomes all needed housing, not just in Whitehorse, but all around the Yukon.

Between 1970 and 1975, Yukon Housing Corporation contracted the construction of bi-level and duplex units in most Yukon communities to meet needs for government staff housing and low-income rental housing. Funding assistance from the Canada Mortgage and Housing Corporation helped to finance an aggressive building program.

Unfortunately, Yukon Housing's initial construction efforts were no more energy efficient than what was being built in the private sector — 2x4 frame houses based on southern designs.

Package homes in Riverdale.

Yukon government

Yukon Housing units in Mayo, typical of homes built in most communities in the late 1970s.

Yukon government

(left) Some Yukon Housing duplexes in Dawson City have been modified to conform to the town's historical appearance guidelines. (right) An exception to the early 1970s 2x4 construction standard was a Whitehorse house built on Alsek Road. In 1974, Verne Toews experimented with staggered 2x4 studs on 2x6 plates. He used R-20 insulation and an air-vapour barrier.

ENERGY MATTERS

In 1973, the Arab oil embargo brought an end to almost 30 years of low energy prices. Rather than dampening the Yukon economic boom, it fed the hype. Higher oil prices led to the proposal of an Alaska Highway pipeline to carry oil from Alaskan fields to the lower forty-eight.

In 1977, the Alaska Highway Pipeline Inquiry report anticipated that pipeline construction would bring huge social, economic and environmental changes to the Yukon. In anticipation of future growth, the government released housing lots in Whitehorse and even surveyed and developed a whole new subdivision, McIntyre, which later became the home village of the Kwanlin Dun First Nation.

Increased oil prices did lead to some changes in attitude towards energy and housing. By 1976, after several years of higher heating oil prices, most houses built on Boswell Crescent, in the new part of Riverdale, were being framed with 2x6s, allowing for R-20 wall insulation.

By then, contractors were also using a six mil plastic air-vapour barrier with a stapled overlap at the joins. But cutouts made for electrical boxes were a route for moisture moving into the walls and cold winter drafts coming into the house. It was 1981 before plastic boots that seal around electrical boxes became commercially available here.

Many Yukoners responded to increased home heating costs by installing auxiliary woodstoves to complement electric baseboard or oil heating. Eventually, this concentration of wood burning appliances in Riverdale would lead to air quality problems.

Government responds

As energy costs rose, federal government agencies with energy and housing responsibilities understood the consequences and began to respond. The federal government department of Energy, Mines and Resources studied energy conservation options and introduced the Canada Oil Substitution Program to encourage displacement of oil as a fuel. In the Yukon, most people used the program to buy woodstoves. Some applied the grant towards better home insulation to reduce their consumption of home heating oil.

Canada Mortgage and Housing Corporation developed guidelines to help measure energy efficiency in housing.

In western Canada, the Saskatchewan Research Council experimented with building envelopes that used tighter air-vapour barriers and more insulation to better contain the energy used to heat buildings.

Employees at Yukon Housing paid close attention to these national developments. Energy efficiency was even more important here because of our severe climate and high energy costs.

✓ Foundation

Yukon government

Every home needs a solid foundation. The appropriate one will depend on ground conditions and your need for space.

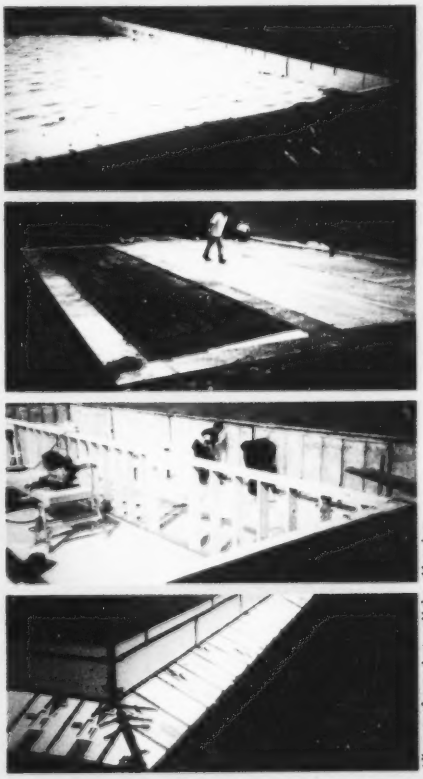
- Check for permafrost because it demands special approaches.
- Find out about ground drainage.
- Consider using a pressure-treated wood foundation (PWF) on perimeter concrete footings as an energy efficient foundation approach.
- Calculate whether or not a full basement might be a cost-effective way to increase usable space.
- Consider whether to use a crawl space foundation as storage space. A four-foot space can be used for this purpose.

Buyers and renovators take note:

- Houses from the 1950s and 1960s usually have concrete foundations. Retrofitted rigid foam insulation applied outside can limit heat loss through foundation walls and stabilize heating loads.
- Radon gas is common in some areas and moves easily through porous soils. Check that there is appropriate sealing and/or ventilation to deal with it.

Building on permafrost

(above) Metal space frames are now a proven foundation for building on permafrost, although wood cribbing is more common. (right) This sequence of photos shows an experimental approach being tried in Ross River. A conventional PWF crawl space foundation was built on compacted earth inside a styrofoam box.



All permafrost photos, Yukon Housing

By 1979, Yukon Housing was seriously investigating the energy efficiency of its own housing units by making some of the country's first energy audit assessments. Detailed hand calculations of energy losses took two to three days per house. The energy measurements contributed to Energy, Mines and Resources efforts to develop a national energy audit approach. With the information collected, Yukon Housing began to consider a program of upgrades to its housing.

The shortcomings discovered in its units highlighted the potential for energy-saving design and building approaches for new housing. So in 1980, Yukon Housing issued a tender for construction of two houses in Haines Junction, with the tender award to be determined by the energy efficiency of the designs submitted. The successful bid would have to meet a maximum energy consumption target of 50 watts per square metre.

Yukon Housing hoped to influence the construction industry to adopt new approaches by demonstrating what was possible.

Yukon ingenuity — a model for R-2000

Graham McDonald

Wayne Wilkinson

Building contractor Larry Turner won the 1980 tender for two energy efficient houses in Haines Junction (above) and Wayne Wilkinson managed the project for Yukon Housing. They started with the work done by Harold Orr at the Saskatchewan Research Council, and Canada Mortgage and Housing Corporation's *Measures of Energy Efficiency in Houses*, and developed an elegant building approach that gave good wall insulation values (R-28), decreased thermal bridging and made it easier to maintain an intact air-vapour barrier.

Basic construction was single wall 2x6 with the plastic air-vapour barrier applied to the inside of the studs. Turner's major innovation was 2x3 strapping run horizontally on the inside of the stud wall, over the top of the plastic. This created a space inside the air-vapour barrier where wiring, electrical boxes and small diameter plumbing could be installed.

The houses were the first in the Yukon to use acoustical sealant — a black, goopy adhesive — to join the air-vapour barrier, "folded over three times" before it was stapled, Turner remembers. "We learned we didn't have to go to that extent" to get a good seal.

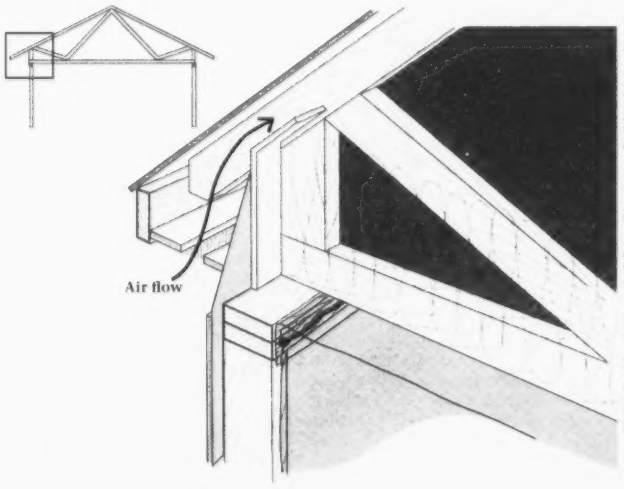
Turner had to rip 2x6s into 2x3s for the interior wall strapping and peel insulation off R-12 batts so it would fit the 2x3 cavity. Despite his best efforts to get the insulation the right thickness, Turner says that there was still some bulging drywall.

The Haines Junction houses also featured special roof trusses, extra attic insulation and early heat recovery ventilators that used heat from exhausting air to warm incoming fresh air.

In 1980, acoustical sealant had to be specially ordered. Today, it, 2x3s and R-8 insulation are all readily available.

The two Haines Junction houses attracted national attention. Representatives from Canada Mortgage and Housing Corporation, Energy, Mines and Resources, and the Saskatchewan Research Council all came to the Yukon to view the practical application of advanced building technology.

Raised-heel truss



From: CHBA Builders' Manual, ©Canadian Home Builders' Association

Kilrich Industries of Whitehorse produced the first standard raised-heel trusses for the Haines Junction houses. After its new truss plant opened in 1985, it built nothing else. Trusses with a 14-inch raised heel (12 inches for R-40 insulation and two inches of air space) have been a Yukon standard ever since. By 1989, they were being used all over the country.

Individual innovation

Two pioneering private houses were erected in the Whitehorse area in the early 1980s — the Sugimoto and the Sylvestre houses.

Sugimoto house

In 1980, Sumire Sugimoto built her house — one that still stands out from its neighbours on Redwood Street in Porter Creek. The one and a half storey house is angled on the lot, facing south. It features 12-inch thick double wall construction. The 60-degree roof slope allows surface mounting of flat plate solar collectors to pre-heat water going to the hot water heater. Twenty-two years later, the solar hot water system still cuts energy costs nine months out of 12.

Sylvestre house

In 1981, in Wolf Creek, the Yukon's first country residential subdivision, contractor Dave McLellan (later, an R-2000 builder) constructed a home for Margrit Sylvestre to her design. She based it on Saskatchewan Research

The Sugimoto house. The 100-gallon tank next to the hot water heater holds water warmed up by the solar collectors. The water from the collectors drains into the tank when they are not in use, protecting them from freezing. The small pump circulates water up to the solar panels.

✓ Framing

In the Yukon, 2x6 walls are the normal energy efficient framing, with 2x3 strapping, although other approaches are possible.

This wall structure is usually combined with 14-inch raised-heel roof trusses that allow a full 12 inches (R-40) insulation in the attic space.

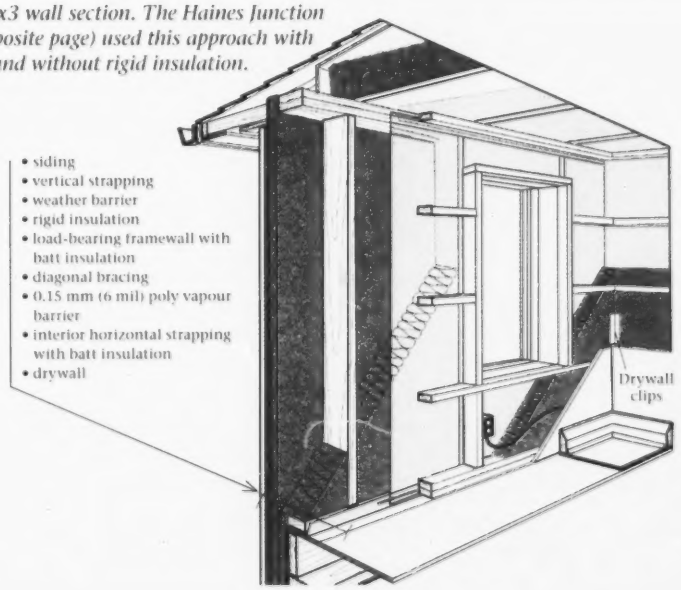
The R-2000 building program has resulted in dozens of incremental improvements to standard framing methods. Most of them have evolved to limit the amount of thermal bridging (movement of heat) through the framing inside the building envelope. R-2000 contractors and people who have built under the Green Home program are familiar with these approaches and incorporate them in their building.

Consider investing in the Canadian Home Builders' Association *Builders Manual,* produced for R-2000 builders. It deals with all aspects of energy efficient home construction.

If you are a buyer or renovator, find out about existing construction details and insulation levels. Some building designs may be harder to upgrade than others. You need to know what you are dealing with before you develop a plan of action.

An Energuide for Houses audit of a house you are considering buying could help you to make that assessment.

2x6 with 2x3 wall section. The Haines Junction houses (opposite page) used this approach with sheathing and without rigid insulation.



From: CHBA Builders' Manual, ©Canadian Home Builders' Association

Courtesy of Margrit Sylvestre

The Sylvestre house. The interior 2x4 wall supports the sheathing seen in the construction photo. The outer 2x4 stud wall is ready for insulation, wind wrap and siding. A later addition on the south side now restricts solar gain.

Council work and other energy efficiency reading.

The Sylvestre house is a square, two-storey design that gives it a good surface-to-volume ratio (minimum surface area for maximum contained volume). Most of its windows are placed on its south-facing side, almost none on the north. It features 12-inch, double wall construction with a four-inch gap between the stud walls. It is built on a fully insulated, pressure-treated wood foundation.

The Saskatchewan Research Council approach offered three benefits. First, it minimized thermal bridging through wall sections; second, it provided a thick wall cavity for insulation; and finally, it allowed for a 2x4 wall cavity where plumbing, electrical wiring and junction boxes could be installed without affecting the integrity of the air-vapour barrier. In the Sylvestre house, sheathing was placed on the outside of the interior stud wall, offering good backing for the air-vapour barrier.

Economic downturn

Although exciting things were happening on the housing scene in the early 1980s, by 1982, the Yukon economy had collapsed.

The record high metal prices that marked the end of the 1970s dropped; Whitehorse Copper Mines shut down in 1981, and in 1982, United Keno Hill Mines and the Cyprus Anvil Mine in Faro — the territory's economic mainstay — both announced layoffs and then closures. In the face of economic uncertainty, housing starts fell.

That same year, Energy, Mines and Resources launched the R-2000 energy efficient housing program. Its goals were similar to the experimental houses built by Yukon Housing in Haines Junction, but initial Yukon interest in the program was low. The first R-2000 house, built on Ponderosa Drive in Porter Creek C, did not sell for over a year.

Much of the focus in residential home building shifted from new construction to renovations, and a new word, retrofitting, became common in the construction trades. The groundwork for retrofitting was laid over the next several years.

In 1982, Energy, Mines and Resources involved the Yukon as one of four jurisdictions in Canada working to develop a standard method to conduct energy audits. The Enerkon pilot study contracted Larry Turner, Bob Baxter, Wayne Wilkinson and Reid Crowthers & Partners to conduct audits on 100 homes. They prepared detailed, computerized heat loss reports for each house audited.

Yukon Housing

Boarded-up houses in Faro, after the mine closing.

The audits showed homeowners where their houses were wasting energy and what they could do about it. Audit reports also told them how long it would take to recover the cost of improvements through energy savings.

Builders buy in

Bob Collins, the Yukon government energy analyst, believes that the single most important event to raise energy awareness in the building and contracting community took place in 1983. A training and renovation program, funded by the federal-territorial Conservation and Renewable Energy Demonstration Agreement (CREDA), equipped 20 Yukon builders with state of the art techniques to achieve better energy efficiency in buildings.

For a month, the builders attended class sessions in the morning and worked on a residential retrofit during the afternoon. After the training they went on to retrofit two of Yukon Housing's Whitehorse seniors' facilities: the Alexander Street seniors' apartments and Greenwood Place on Lambert Street at Third Avenue.

Yukon Housing found that energy efficiency improvements to the buildings significantly reduced their ongoing operating costs. Builders learned that attention paid to small details, such as weather stripping and caulking, was significant when it came to energy savings.

Graduates of the CREDA training program went on to make continuing contributions to high quality, energy efficient construction in the

In the first multi-unit institutional retrofit in the Yukon, workers and trainees applied strapping and insulation to the foundation and exterior of this seniors' housing on Alexander Street, wrapped the building with wind barrier material and re-sided it. They also installed additional attic insulation and energy efficient windows and doors, and did detailed weather stripping and caulking around windows, doors and sills.

✓ The envelope

The energy efficiency of contemporary housing depends on the interlocking performance of envelope elements: air-vapour barrier, windows and doors, insulation and wind barrier.

- The air-vapour barrier keeps heat inside the house, and moisture out of the house framing where it could cause structural damage.
- Windows account for up to 35% of heat losses in an average house.
- Insulation restricts the movement of heat towards the outside of the house. Framing provides cavities in which insulation is placed.
- Windproofing (Tyvek) stops cold air from penetrating the envelope from outside.

Options for insulation include fibreglass, styrofoams and cellulose. Depending on the material, these may be applied as friction fit batts, rigid insulation, or blown into place. All are rated with R-values that indicate their resistance to the transmission of heat. Expanding insulating foams are effective seals around door and window frames.

Homebuyers or renovators considering an older house will often find room to improve the sealing of the envelope. Gaskets around electrical outlets, caulking around baseboards, windows and doors, and weather stripping on opening windows and doors, all can minimize the cold air being drawn into a house.

More extensive retrofits, such as window and door replacements, increased attic insulation, rigid insulation on outside walls and a Tyvek wrap, will improve the efficiency of older houses. An EnerGuide for Housing audit and modelling work will identify the most cost and energy efficient improvements.

Energy Solutions Centre

Wayne Wilkinson using a blower door to test air tightness. Depressurizing the house, as part of an energy audit, accentuates any air leaks and identifies areas for weather stripping and caulking. Houses built under the R-2000 and Green Home programs must pass a blower door test before they can be certified.

At another seniors' complex in Whitehorse, Greenwood Place, the retrofit was less extreme because it was a newer building than the one on Alexander Street.

The retrofit of Skookum Jim Centre in Whitehorse took place over two years and added a second storey. This addition resulted in the first-ever order for raised-heel trusses from the Champagne and Aishihik Enterprises truss plant. This project was the first in the Yukon to use Tyvek wrap.

territory. Contractors who missed out on the first round of retrofit training successfully petitioned the government for further training opportunities.

The following year, the same training approach was taken with the Skookum Jim Friendship Centre rebuild. First Nations trainees recruited from each Yukon community worked on the project and took new knowledge back home.

The retrofitting techniques applied and tested on the Yukon Housing and Skookum Jim projects became construction trade standards. They are used, with continuing improvements, to this day. Retrofitting can make older buildings more comfortable and cut ongoing energy operating costs.

The CREDA program continued to finance retrofits of almost 80 individual seniors' homes as well as other energy efficiency experiments.

In 1983-1984, Yukon Housing conducted a study of energy consumption in Yukon homes. This expanded pilot project, funded by Energy, Mines and Resources, looked at 600 houses and found significant energy shortcomings and lots of room for improvement.

The Saving Energy Action Loans (SEAL) program, launched by the Yukon government in 1985, was a response to these findings. It financed retrofits, oil burner replacements and new windows as part of an overall government effort to reduce energy consumption and dependence on imported oil.

Renewed optimism

By the mid-1980s, the Faro mine had a new life as Curragh Resources, and optimism grew. Porter Creek C was still the new housing area of Whitehorse and some R-2000 units were part of the mix.

Even those who were not using the R-2000 program were affected by the goals it set. Housing in Whitehorse was being built to a higher standard than anywhere else in the country. Building envelopes, in particular, were constructed with careful attention to air-vapour barrier integrity and good insulation levels in both walls and attics. High attic insulation values were based on local truss design innovation.

Yukon government

Housing in Porter Creek C.

Yukon government

This Yukon Housing 13-suite apartment building in Dawson City has had low energy costs ever since it was built in 1987. Designed by Boreal Engineering to be constructed on permafrost, it features R-28 walls, R-40 attic insulation and an R-60 insulated floor.

✓ Windows

Windows are an important consideration in any energy efficient building project. Mike Youso, an experienced energy specialist, advises clients to spend their money on the best windows available.

Renovators or homebuyers should know that the technology has improved so much recently that 10-year-old windows may now be considered obsolete.

The Yukon has its own manufacturer, Northerm, which supplies much of the Yukon market. Glass and building supply centres offer products from other manufacturers.

Windows are a critical factor in the building envelope because they can leak heat through the glazing and frame, and around the opening parts. Poor sealing between the window frame and rough frame opening is common in older houses.

Windows can also be a source of major heat gain for a house if they can collect solar heat. According to Youso, in a typical well-designed R-2000 Yukon house, about 25% of the annual heating energy is provided by the sun, about 25% by internal gains from people, lights and appliances, and the remaining 50% by the heating system.

Solar heat gain works well in the Yukon since low winter sun angles mean maximum solar penetration when we most need it. High sun angles during the summer limit the potential for overheating.

Windows in Canada now have an Energy Rating (ER) that tells buyers whether they will provide a net energy gain for the building. The ER equals solar gain minus conduction and air leakage losses for a given window.

Triple pane, low-e argon-filled windows offer light, solar gain and a positive energy rating.

Today, high performance windows must have an ER rating of +2 or greater. That compares with an ER rating for an R-20 wall of -6. The best performing windows can have ERs as high as +15.

ER ratings are affected by the number of panes; the conductivity of the spacers between them; the coatings on the glass; and the type of gas filling the space between the panes.

Fixed windows have higher ER ratings than opening windows. For example, a double pane, low-e argon-filled window has an ER of +5 if it is fixed and only -8 if it can be opened.

Youso has found that the greatest energy savings are achieved with three pane, low-e, argon-filled windows on the north and west, and three pane, argon-filled windows on the east and south where solar gain is available in the winter.

Yukon government

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Energy efficiency in the mainstream

In the 1980s, federal and territorial government officials and the Kwanlin Dun First Nation agreed to relocate the Kwanlin Dun village from the Marwell industrial area to the McIntyre subdivision, the area that had been laid out and serviced in anticipation of the need for Alaska pipeline housing.

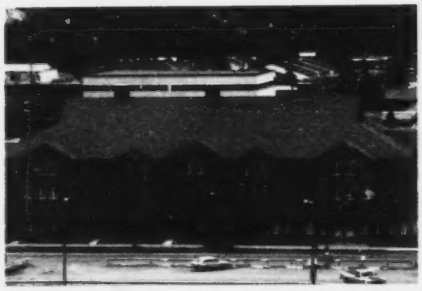
Kwanlin Dun formed a construction company, Tagish Kwan, that licenced the modular Nascor foam panel wall system and set up a production plant in Marwell. The Nascor system provided R-30 wall insulation values and these were complemented by R-40 ceiling insulation. Neil Letang, who managed the village construction in 1987 and 1988, describes it as "the biggest single conservation-oriented building project in the Yukon."

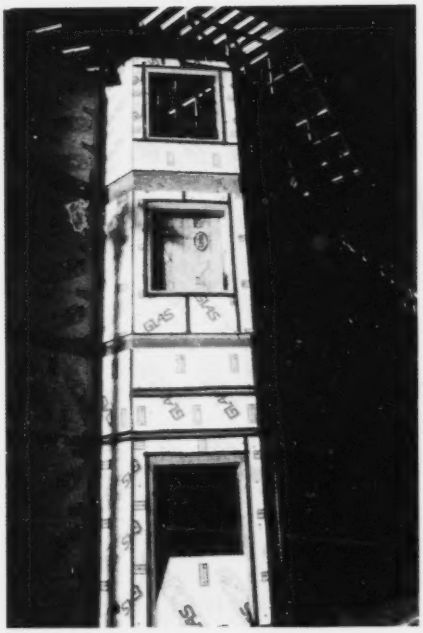
Energy efficient housing was so much a part of the Yukon scene that by 1988, the carpentry program at Yukon College was putting all of its third-year apprentices through the R-2000 training program.

That same year, Closeleigh Manor — the first R-2000 multi-unit residential development in the country — was completed. Yukon Housing won a national award for this 30-suite seniors' residence. Extensively monitored after construction, the building proved to be so efficient that Yukon Housing removed five of its 10 oil-fired boilers after the first year of operation. Since only four were regularly needed, that still left one extra as a spare.

Monitoring also revealed that far more air was being moved through the building than was needed and that a steam-producing humidifier accounted for a third of the building's electrical consumption. Variable-speed motors were installed to make air handling and heating more responsive to actual demands and the humidifier was taken out of service.

Also in 1988, Yukon Housing formally launched an energy audit program that it made available to homeowners





All Closeleigh Manor photos from Yukon government

Closeleigh Manor, 1988. First-ever multi-unit residential R-2000 project.

McIntyre subdivision.

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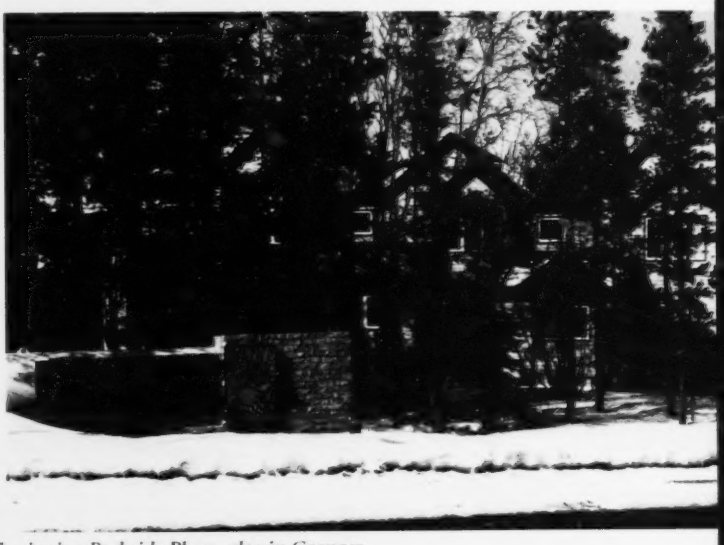
Energy efficient construction through the R-2000 program continued. Five of the first six houses built in the Granger subdivision were R-2000 certified.

However, in the early 1990s, the R-2000 certification program in the territory collapsed. The Canadian Home Builders' Association – Yukon, which had been delivering the program, was dragged down by the leaky condo problems affecting its affiliate in British Columbia. Some builders continued to build homes to the R-2000 standard, but they did not register them under the program.

Quiniscoe, builder of the first Granger homes, went on to build Parkside Place in Granger. This multi-suite condominium, designed by Charles McLaren, won a national award for



(left) First R-2000 homes in Granger built in the late 1980s. (right) Award-winning Parkside Place, also in Granger.

✓ Materials and finishing

Environmentally friendly homes pay attention to the materials and finishes they use. Some examples are:

- products that use less energy when they are made (low embodied energy),
- materials that do not have to be transported over long distances,
- products that weigh less and require less energy to be transported,
- products that incorporate recycled materials, and
- materials and finishes that do not emit volatile organic compounds (VOCs)

Increased awareness is encouraging consumers to make choices based on these kinds of considerations. Current R-2000 standards require builders to choose from a list of "healthy" building materials and finishes that contribute to better indoor air quality.

Since 1988, Environment Canada's Environmental Choice program has maintained an extensive list of products and services that put less stress on the environment. Check out *environmentalchoice.com* for products you might use for your building project, or in day-to-day life.

In an ideal world, Yukoners might all be framing their houses with Yukon lumber. Local wood, locally processed, uses less energy in its conversion to a building material than timber cut and processed elsewhere and then transported thousands of kilometres.

Right now, however, dimensional lumber is not being produced here and that means that siding, flooring, panelling, cabinetry and timber framing are the best opportunities for the use of locally manufactured timber resources. Choosing them also means employment for local harvesters, processors, trades and craftspeople.

Keep in mind that some manufactured construction materials now incorporate recycled materials which means an energy saving in their production.

Yukoners have a strong tradition of recycling everything from lumber to doors to whole houses. Recycled materials cut waste, extend use and save landfill space.

Recycled door and remanufactured fir flooring make the most of salvaged materials.

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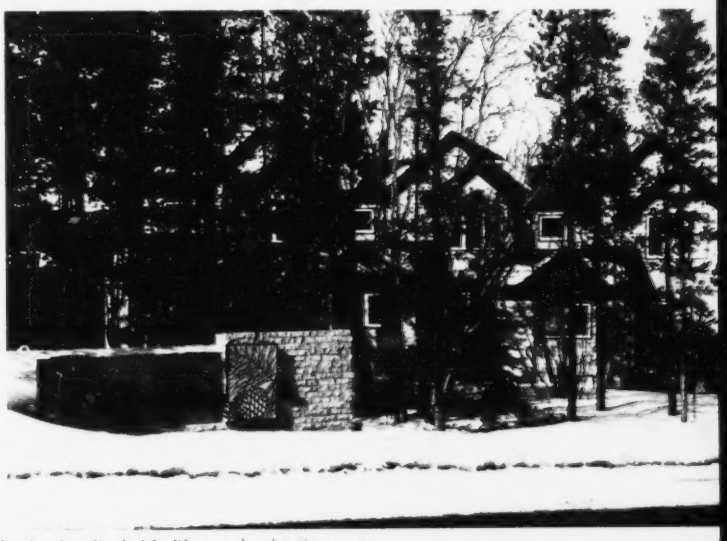

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Yukon government

Northern Building Science Centre

In 1990, Natural Resources Canada was eager to field test a new rigid monocoque building design developed for possible use in permafrost locations. Designed to be constructed on-site with dimensional lumber and plywood, the test structure was built at Yukon College in 1991 by pre-apprenticeship carpentry trainees. The project evolved to become a test bed for off-grid hybrid alternate energy technology using a wind generator and photovoltaic solar collectors to power a battery/inverter system. It even had a composting toilet.

The original building design worked but high material costs and space-limiting construction details meant that it was not tried again. The four bearing points of the building foundation are now hidden behind skirting.

Twelve years later, the battery bank and inverter have been removed from the building. Outside, the tracking solar photovoltaic collector has been replaced with a larger, rigidly mounted array and the wind generator is in need of work. The solar/wind system does feed a small amount of power into the grid.

With few of the original proponents still involved, the lesson learned is that alternative approaches require continued commitment in order to work.

environmentally sensitive design. Built on a small, pie-shaped lot, it makes efficient use of land, gives each unit a sense of privacy, and preserves much of the surrounding environment.

The 1990s building template

Although the R-2000 program was not being delivered in the Yukon through much of the 1990s, it had established a basic template followed by most conscientious builders. Many new homes had:

- R-28 or better wall insulation,
- R-40 attic insulation,
- active ventilation systems with heat recovery units,
- double or triple pane, low-e or argon-filled windows,
- sealed air-vapour barriers, and
- Tyvek weather barriers.

Pressure-treated wood and concrete perimeter footings were the foundation standard. Basement walls were usually insulated to a minimum of R-20.

This meant that most new Yukon construction was being built to a standard that, 20 years before, had been called "super insulated."

BEYOND ENERGY

Further into the 1990s, new considerations were factored into home building decisions.

Greener R-2000

In 1994, the national R-2000 program raised the bar for builders by requiring water conservation measures. It also introduced lists and point systems for the use of environmentally friendly and recycled materials. The software modelling package, HOT 2000, became still more sophisticated, allowing designers and builders to plug in very specific construction details to see how they would affect the efficiency of their design.

EnerGuide for Houses

Natural Resources Canada initiated the national EnerGuide for Houses rating system in 1998. Yukon Housing, involved in the evolution of the program since its very beginnings back in the late 1970s, oversaw its implementation and modification for the Yukon. It continues to set a standard against which both new and existing housing can be objectively compared.

In 1993-1994, the Carpenters Union, Local 2499, provided its apprenticing members with a training opportunity by building the Carpenters Hall student residence at Yukon College. Apprentices got hands-on experience building this solid, energy efficient, two-storey building.

Certified Green Home program

In another attempt to get more homebuilders to construct greener houses, Yukon Housing introduced Green Home certification in 1998. It gives contractors and self-builders access to computer energy modelling tools to test out and refine their designs without having to be R-2000 certified. Those who choose to build a Green Home also get a break on their mortgage interest rate. This saving, over the term of the mortgage, may cover much of the additional cost of building "green."

Although the Green Home program does not require builders to be R-2000 trained and certified, it demands the same EnerGuide rating and mechanical features as called for by R-2000. However, it does not incorporate the R-2000 water conservation and materials requirements.

The Green Home program originally attracted people who wanted a break on their mortgage rate. Now, fully half of the people building under the program say they are doing it for environmental reasons and because they like the long-term operating savings a Green Home can deliver.

Yukon Housing has also become the Yukon delivery agent for the R-2000 program, breathing new life into the certification. Based on its experience with certified Green Home, Yukon Housing now allows R-2000 certification for self-builders, provided they work under the supervision of certified and experienced R-2000 builders.

Today, four out of ten people who chose to build under the Green Home program take the extra steps to get them R-2000 certified.

A Yukon survey conducted in 2002 confirmed that most people are choosing to build very close to an R-2000 or Green Home standard. So close, in fact, that the incremental cost difference between ordinary and R-2000 home construction may be as little as three percent.

Yukon government

Erica Heyligers outside her R-2000 home with energy auditor Wayne Wilkinson.

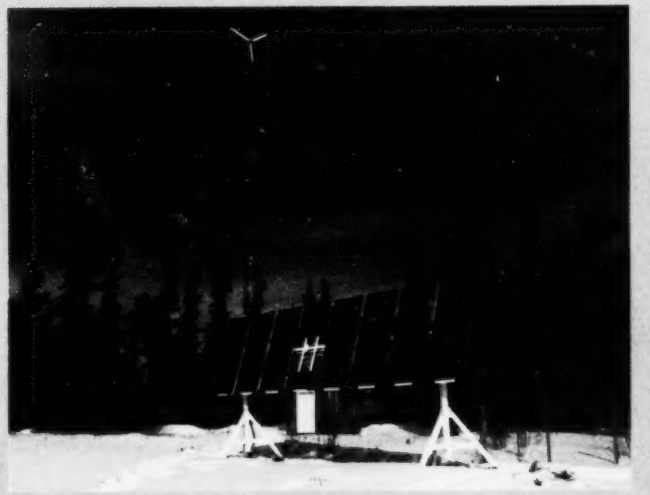
Yukoners clearly appreciate that energy efficiency and cost savings go hand-in-hand. Some pride themselves on building with minimal impact. On the following pages, we feature some home building pioneers who have gone beyond program targets to create exemplary green homes. If you know of others, the Energy Solutions Centre would like to hear about them.

✓ Energy systems

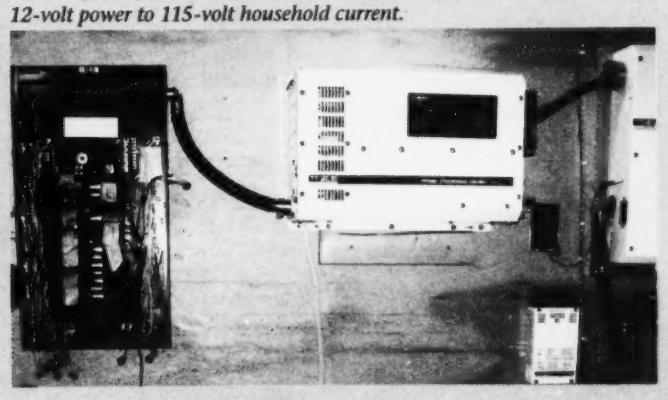
Most of us choose housing near the electrical grid and start with the assumption that we will have power in our homes. In areas where hydro- or wind-generated power is available, that's a good environmental choice.

If you are living off-grid or in a community that uses diesel-generated power, alternate power sources may be worth considering. Micro-hydro, solar photovoltaic and wind generating systems are working for some people. These systems have higher initial costs than plugging into the grid and require a continuing commitment of care and attention to keep them operating at maximum efficiency, but they can free you from ongoing power bills.

The Yukon government's energy solutions group of companies — Energy Solutions Centre, Yukon Development Corporation and Yukon Energy — offer both information and programs to help you find your way to an alternate energy solution. For more information online, go to "programs" at *www.nrgsc.yk.ca.*



(left) Wind turbine and photovoltaic array at Northern Building Science Centre. (below) Power conversion centre (inverter) at Luet home converts 12-volt power to 115-volt household current.



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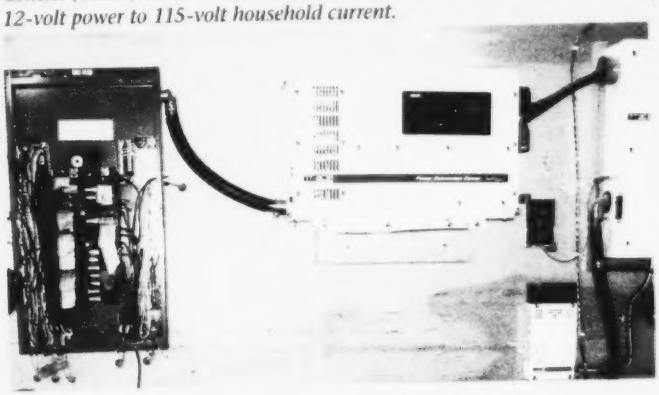


ELLIS HOUSE

Jennifer Ellis' house in Cowley Creek is the first — and so far, only — straw bale home in the Yukon. The minimally processed timber that makes up the frame, and the straw bale walls, give it a low embodied energy rating.

A post and beam frame and scissor truss roof are the structural elements of the house. Straw bales fitted outside the frame and around windows and doors form the walls and provide insulation. The walls do not have a vapour barrier; the stucco goes right on to the bales and stucco wire, both inside and out. Together, the stucco and straw create a "sandwich" that provides an R-35 rating.

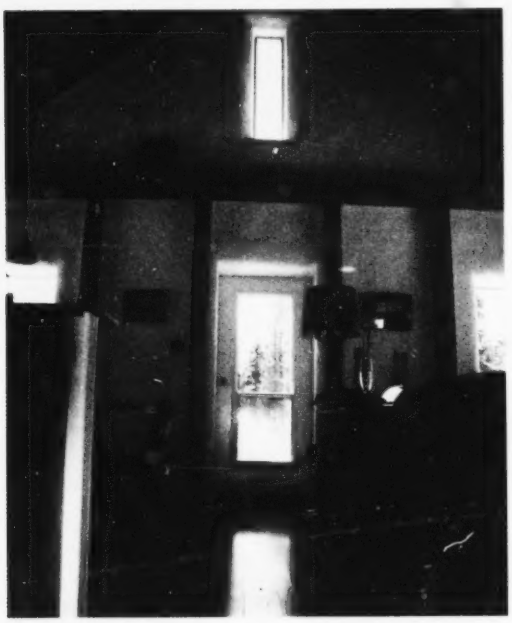
Jennifer organized straw building seminars during construction to allow people to learn the technology and get hands-on experience.

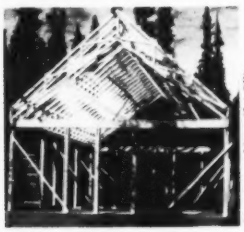
The fir flooring in the house was recycled from a Whitehorse Copper mill tank and inside doors were scavenged from several sources.

A recycled vintage automobile window was used for the "truth" window — a straw house tradition.

Courtesy of Jennifer Ellis

"If I had a dollar for every three-little-pigs-and-big-bad-wolf jokes I've heard, I could take a nice vacation!"





Courtesy of Jennifer Ellis

Courtesy of Jennifer Ellis

Courtesy of Benedek/Kramer

BENEDEK/KRAMER HOUSE

Mike Kramer and Christine Benedek's home in Spruce Hill is both R-2000 and Green Home certified. But even without the programs, Kramer says, he would have built the same way. A former Outward Bound instructor, he values the environment and also appreciates the savings he gets with a green house. It uses about $250 in propane and three to four cords of wood per year.

The house features an open design which allows for good solar gain and air circulation. Randy Wiebe, a certified R-2000 builder, ran the house design on the HOT 2000 program to refine its features, and also framed the house. It uses rigid SM insulation over 2x6 studs with no sheathing and 2x3 interior strapping to get R-33 wall insulation values. With blown-in cellulose attic and roof insulation, values are a minimum of R-50.

A local miller, Harry Atkins, supplied local pine for siding and trim.

"The savings on energy bills are unbelievable." (Mike Kramer)

✓ Heating

Today, air and ground source heat pumps and supplemental solar hot water and solar air heating systems are options for homeowners — along with the traditional residential heating sources: oil, wood, propane and electric.

Increasing fossil fuel prices are causing more Yukoners to consider the operating costs of heating systems. Priced out over their lifecycle, renewable energy systems such as heat pumps and solar collectors can be a better deal, despite higher initial costs. On some alternate systems, homeowners can see a return on investment of up to 20% per year.

Wood heat still ranks high as a consumer choice in the Yukon, with better reason these days than ever before. High efficiency EPA certified wood burning appliances reduce wood consumption by about 30% and smoke by about 90%.

New emerging technologies can help improve efficiency and reduce energy costs in retrofit applications. For example, oil-fired hot water combination systems can both heat your home and remove the need for a separate electric hot water tank.

For more information on emerging technologies and advances in wood heat, contact the Energy Solutions Centre.

This condensing propane furnace at the Benedek/Kramer house uses plastic piping for both combustion air and exhaust.

✓ Ventilation

Energy efficient houses are built with tight envelopes that almost eliminate uncontrolled entry or escape of air. For this reason, ventilation systems that bring in fresh air and exhaust stale air are particularly important.

In R-2000 and certified Green Home houses, as well as in some homes built outside these programs, air exchange is accomplished with the use of heat recovery ventilators (HRVs) that use heat from the exhaust air to pre-heat incoming fresh air.

In the Yukon, HRVs installed in the first R-2000 homes suffered unfairly from bad reputations. In the early days, when the program called for a high number of air exchanges, homeowners found that HRVs frosted up under Yukon conditions.

Today, HRVs certified for use in R-2000 and certified Green Home houses have all been tested to -25°C. With current R-2000 air exchange requirements, they operate reliably in temperatures as cold as we see in the Yukon. This is true even of older units if they are regularly maintained and cleaned.

Courtesy of Benedek Kramer

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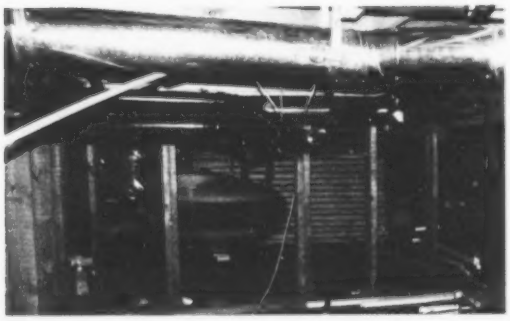
HICKLIN HOUSE



Janne Hicklin has worked around energy issues in the Yukon for over 20 years and much of what she has learned shows up in her Mary Lake house. Determined to build as environmentally as possible, she chose a natural clearing on her lot and watched the sun move around it for a year. Then she dug the footing trenches by hand and oriented the house south-southwest.

A super insulated design, the house features R-36 insulation on its centre core and R-40 on the 12-inch thick north- and west-facing single storey walls. Windows are double and triple pane, low-e, argon-filled on the south and east sides.

"Building my own home was a chance to try greener approaches than 'conventional' design, construction and systems."

Janne originally planned to use radiant heat for the house but ultimately chose a high efficiency air-source heat pump that works like an air conditioner in reverse. Below -15°C, wood heat is used as a supplement. Below -25°C, an electric coil provides heat to keep the house from freezing up if it is left unattended.

Janne says that she was willing to pay a premium over the cost of an oil boiler to avoid having to use a fossil fuel. The heat pump uses hydro-generated electrical power very efficiently, at about one third the cost of electric resistance heat (baseboards or electric furnace).

In the crawl space, a 60-gallon tank receives filtered grey water from the shower, laundry and bathtub. A separate pump and pressure tank feeds it to the low-flush toilets.

Janne's commitment to recycling is evident throughout the house, from the copper (salvaged from the old Whitehorse Rec Centre) used as inserts in local pine kitchen cabinets, to recycled doors from the landfill.

Fir from a domestic water tank at the Whitehorse Copper mine was recycled at the Sloughmill into the flooring and trim used throughout the house.

(right) Gunnar Nilsson added value to locally harvested and recycled wood at his Sloughmill. (inset) Fir flooring remanufactured for Janne Hicklin.

Yukon government

FORDE HOUSE

"Working together with people in the building community made this a very satisfying, collaborative experience for me."

Jan Forde's small R-2000 certified Green Home in Spruce Hill is testament to the skills of Yukon craftspeople. She credits Dave Brooks, Mike MacDonald and Theo Stad for the collaborative design effort that yielded a unique combination of perimeter stud wall construction and timber frame interior work.

A low embodied energy rating for material was ensured by using local Yukon pine for the timber frame features, flooring, doors and cabinet work. Annie Lake Road cabinet maker, Claire Demarais, whose work is also featured in the Hicklin and Ellis houses, did the cabinet work here.

✓ Water conservation

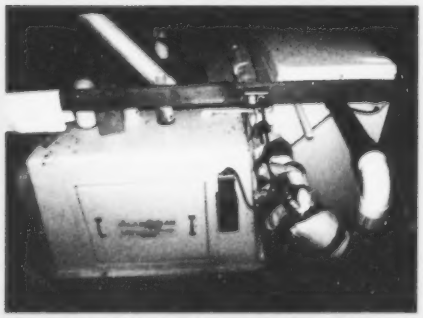
Since 1994, water conservation requirements have been part of the R-2000 program. Low-flush toilets and low-flow showerheads and faucets are installed as a matter of course.

If you are buying or retrofitting, particularly if your house is not connected to municipal water and sewer services and you rely on water delivery, efficient water use can be a big cost consideration.

Yukon Housing is working with two companies, Cowater Systems and Flushmate, to test ultra low-flush toilets. These work well, use only one gallon of water per pressure assisted flush, and are nearing the production phase. Yukon Housing has Canada Mortgage and Housing Corporation comparison tests on other low-flush toilets.

The R-2000 program recognizes the potential for grey water systems. Grey water systems usually discharge through a sand filter for yard irrigation use.

Composting toilets are another option rural residents might want to consider.



(left) The ultra low-flush toilet offers two flushing intensities. (right, top and bottom) The complexity of this composting toilet in the Northern Building Science Centre has limited its utility over the years.

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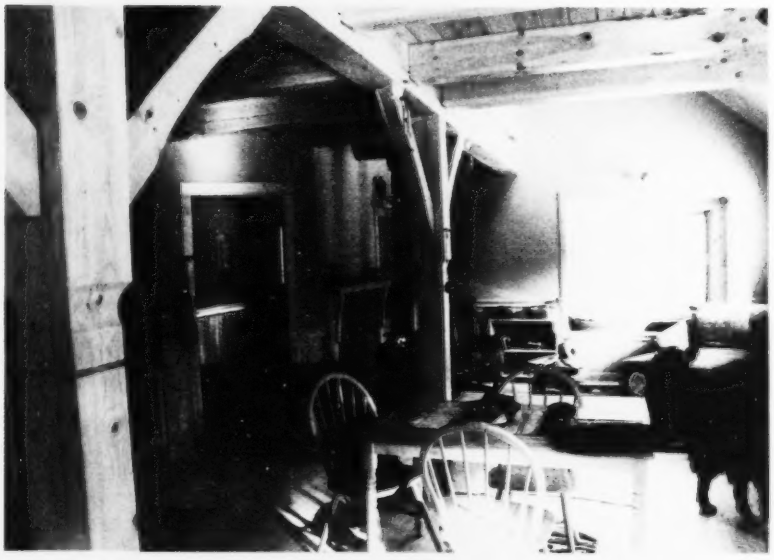

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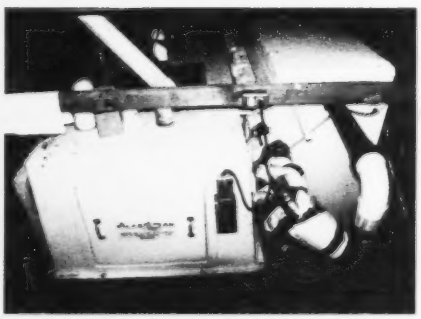
If you are buying or retrofitting, particularly if your house is not connected to municipal water and sewer services and you rely on water delivery, efficient water use can be a big cost consideration.

Yukon Housing is working with two companies, Cowater Systems and Flushmate, to test ultra low-flush toilets. These work well, use only one gallon of water per pressure assisted flush, and are nearing the production phase. Yukon Housing has Canada Mortgage and Housing Corporation comparison tests on other low-flush toilets.

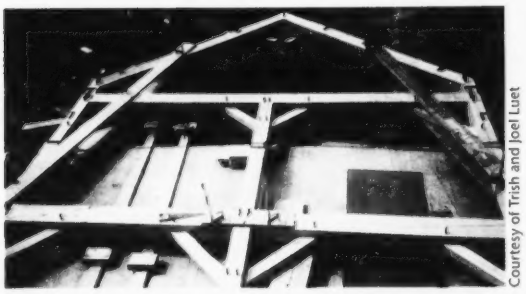
The R-2000 program recognizes the potential for grey water systems. Grey water systems usually discharge through a sand filter for yard irrigation use.

Composting toilets are another option rural residents might want to consider.



(left) The ultra low-flush toilet offers two flushing intensities. (right, top and bottom) The complexity of this composting toilet in the Northern Building Science Centre has limited its utility over the years.

LUET HOUSE



Courtesy of Trish and Joel Luet

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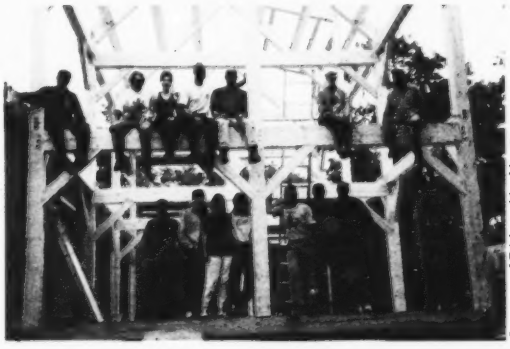


Courtesy of Trish and Joel Luet

Joel and Trish Luet's spectacular 1,900-square-foot timber frame house in the Watson River subdivision hews true to their environmental values. Yukon-grown timber from Watson Lake was re-milled at Gunnar Nilsson's Sloughmill on its way to the building site. Limited processing and Yukon origin give the major structural elements a low embodied energy rating.

The timber frame that took six months to build was assembled in six hours in the summer of 2000, with a crane and a willing crew of friends.

Larson trusses (made of 2x2s for the walls and 2x3s for the roof; see front cover photo) strung over the structure provided adequate insulation space with minimum material usage (R-38 walls, R-40 roof). The Luets chose triple pane, low-e argon-filled windows for maximum energy ratings. Horizontal 2x3 strapping (spaced .127 mm or .5 inches outside the framing timbers to leave room for drywall) allowed for electrical wiring and boxes inside the air-vapour barrier. The air-vapour barrier was draped over the whole building in full sheets and required few joins.

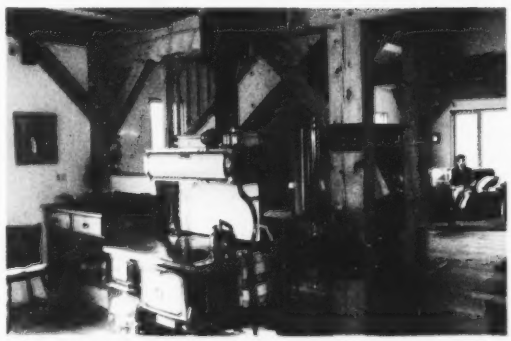
Joel and Trish chose wood, a renewable resource, for their primary heating fuel. They burn it in a 92% efficient Tulikiva masonry stove that burns half as much wood as a conventional woodstove. It radiates heat for hours after each burn. They also use a wood cookstove. Clean-burning propane is used for on-demand hot water and for the 87% efficient monitor back-up heat.

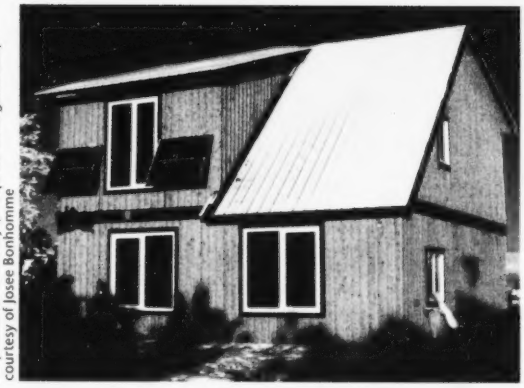
Although the Luets have access to power at their lot, they chose to stay off-grid on a photovoltaic-powered 12-volt battery system with a 115-volt inverter. Energy efficient compact fluorescent and halogen lighting is used throughout. A generator augments the solar panels from November to the end of January.

A low emission turpentine-linseed oil finish was chosen for interior wood and unfinished cedar was used for exterior siding. Cedar was selected so that no finish would be required.

Water conservation is important since the house is on water delivery. They use a low-flush toilet and low-flow showerheads.

"I like the idea of the house lasting longer than it took to grow the trees it's made from."
(Joel Luet)





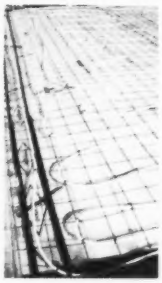
All photos for this story (except for wind generator) courtesy of Josee Bonhomme

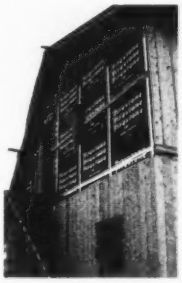
SOLAR WIND LOGICS DEMONSTRATION HOUSE

Josee Bonhomme designed her energy efficient home as a commercial demonstration project running on a hybrid wind/photovoltaic power system. Its southern exposure features large windows for solar gain and two, two-panel photovoltaic arrays.

Josee chose wood, a renewable resource, as her fuel. She burns it in an external boiler that feeds three hot water circuits in the concrete slab floor. The floor was placed over rigid SM insulation and a ground moisture barrier. The boiler was sized to allow it to heat both this building and a larger, future house.

"This is the first phase of a planned longer term building project with the house framed to allow its later use as a garage/guest house."





Scrap gyproc placed behind the drywall in a sun-catching interior wall acts as a heat sink. This simple technique can be used in any building to increase thermal mass inside the envelope and reduce pressure on landfill sites.

High efficiency lighting was used throughout.

Two-inch high-density structural foam insulation (R-15) allowed Josee to use 2x4 walls (R-12) with no sheathing to minimize material use and still get R-27 walls.

Josee used locally milled Dakwakada rough timber for board and batten siding.

✓ Appliance and lighting selection

When your new house is standing and you've done everything else right, don't forget to pay attention to the appliances you buy. The six major appliances in most houses — refrigerator, freezer, dishwasher, range, clothes washer and dryer — account for more than 14% of total energy use in the average home.

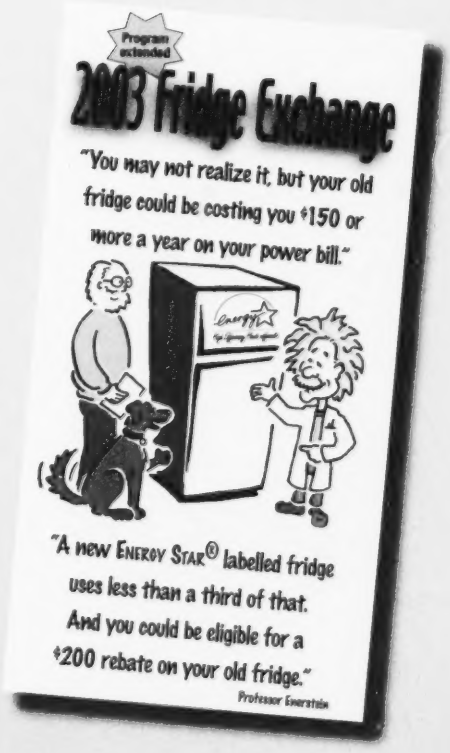
Major appliances sold in Canada have EnerGuide ratings that allow direct comparisons. The lower the rating, the lower the energy consumption. Careful selection of energy efficient appliances can yield savings of 20% to 60% over regular appliances.

High efficiency front-loading washing machines, for example, not only save energy, they also use less water.

Canada is adopting the ENERGY STAR® appliance standard that identifies the most energy efficient appliances in a wide variety of categories. An ENERGY STAR® tag on a computer or appliance means that it is the most efficient in its class.

Major improvements in lighting have been made in recent years, with compact fluorescent bulbs now available in both warm and cool colours to provide lighting quality similar to traditional incandescent bulbs while using a quarter of the power.

Light emitting diodes (LEDs) are also showing up in a variety of lighting applications. They use only a tenth the energy of incandescent lighting.


Program extended
2003 Fridge Exchange
"You may not realize it, but your old fridge could be costing you $150 or more a year on your power bill."
"A new ENERGY STAR® labelled fridge uses less than a third of that. And you could be eligible for a $200 rebate on your old fridge."
Professor Energstein

(left) This high efficiency light draws only 13 watts. (right) The Fridge Exchange program, offered by the Energy Solutions Centre, Yukon Development Corporation and Natural Resources Canada, subsidizes the replacement of fridges that are over 10 years old.

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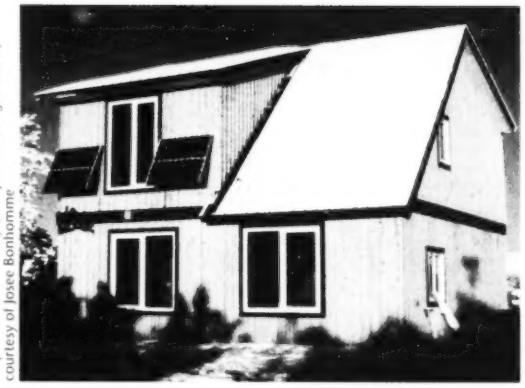

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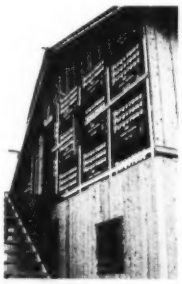

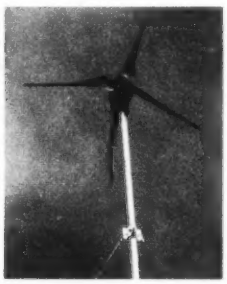

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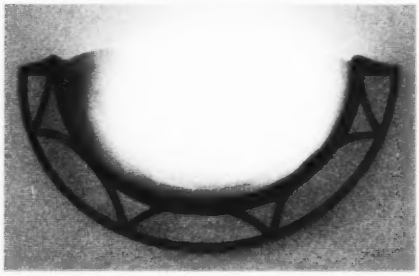

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Association franco-yukonnaise

WHOLE HOUSE RECYCLING *Paul Warner rescued the 1960s vintage l'Association franco-yukonnaise building (above, right) from the wrecking ball in 2000. In a last minute deal, he lined up house, lot and financing in just two days. The living room view determined the house's orientation on a new lot in Spruce Hill. Although placed on a PWF basement and upgraded with new windows, additional insulation and siding, the house's energy efficiency is compromised by original design features. The icicles hanging from the roof illustrate the heat-leaking effects of an older style roof structure.*

ROOM FOR IMPROVEMENT

While new housing has continually improved in the Yukon, and many older houses have been upgraded, there is still room for improvement.

The 1996 Census found that 15% of all Yukon houses needed major repairs, compared to 8% Canada-wide.

Yukon Housing surveys have discovered that many houses built here in the 1970s are in worse shape and deteriorating more quickly than upgraded 1950s and 1960s housing.

Any housing renovation is an opportunity to improve the energy efficiency and decrease the environmental impact of your home.

Whether you are building, buying, renovating — or even recycling a whole house — we hope that the ideas and suggestions presented here will allow you to count yourself among the hundreds of Yukoners who have chosen to make a difference.

ENERGUIDE FOR HOUSES
Advice you can live with

Get high tech information on your home to help you decide on repair and upgrade options that will pay you back in energy savings, and help the environment by reducing greenhouse gases.

- Improve your home's comfort.
- Reduce energy use and save money on your energy bills.
- Plan how to include energy efficiency upgrades when building or renovating your home.
- Rate your home before and after upgrades with a nationally accepted rating.
- Compare the energy efficiency of houses when you're in the market to buy a home or design one.

An EnerGuide for Houses audit includes:

- a personalized computer profile of your house's energy use,
- a cost analysis of potential energy savings,
- an air leakage test,
- possible eligibility for free follow-up audit after retrofitting, and
- an official EnerGuide label for your house.

For an EnerGuide for Houses audit, contact Yukon Housing at 667-5759 or 1-800-661-0408.

Yukon's energy solutions group of companies

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Box 2703 (D-1)
Whitehorse, Yukon Y1A 2C6
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Fax: (867) 393-7071
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All quotes on early Whitehorse houses are from *Exploring Old Whitehorse*, by Yukon Historical and Museums Association. Unless otherwise indicated, all photos by K-L Services.